DEFENSE THREAT REDUCTION AGENCY

The Defense Threat Reduction Agency (DTRA) is actively involved in meeting current threats to the Nation and working toward reduction of threats of all kinds in the future. This covers a multiplicity of disciplines. As a result, the Agency is seeking small business with a strong research and development capability and experience in weapons effects, phenomenology, operations and counterproliferation. (Please noted, DTRA is not interested in weapon development, design or manufacture.) DTRA invites small businesses to send proposals to the following address

Defense Threat Reduction Agency
ATTN: AM/SBIR
45045 Aviation Drive
Dulles, VA 20166-7517

The proposals will be processed and distributed to the appropriate technical offices for evaluation. Questions concerning the administration of the SBIR program and proposal preparation should be directed to:

Defense Threat Reduction Agency
ATTN: AM/SADBU, Mr. Bill Burks
45045 Aviation Drive
Dulles, VA 20166-7517
Tel.: (703) 326-8674
Fax: (703) 810-4675
E-mail: billy.burks@dtra.mil

Use of e-mail is encouraged for correspondence purposes.

DTRA has identified 18 technical topics numbered DTRA 00-001 through DTRA 00-018. These are the only topics for which proposal will be accepted. The current topics and topic descriptions are included below. The DTRA technical offices which manage the research and development in these areas initiated these topics. Several of the topics are intentionally broad to ensure any innovative idea fitting within DTRA's mission may be submitted. Proposals do not need to cover all aspects of these broad topics. Questions concerning the topics should be submitted to Mr. Burks at the above address or to the Topic Authors identified elsewhere.

Potential offerors must submit proposals in accordance with the DoD Solicitation document. Proposal selection will be limited to those proposals in Phase I which do not exceed $100,000 and six months of performance. For information purposes, Phase II considerations will be limited to proposals of $750,000 and 24 months of performance, or less.

DTRA selects proposals for funding based on the technical merit of the proposal, criticality of the research, and the evaluation criteria contained in this solicitation document. As funding is limited, DTRA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and filling the most critical requirements. As a result, DTRA may fund more than one proposal under a specific topic or it may fund no proposals in a topic area. Proposals which cover more than one DTRA topic must be submitted once, referencing the several areas of applicability.

While funds have not specifically been set aside for bridge funding between Phase I and Phase II successful proposals, the potential offeror is advised to read carefully the conditions set out in this solicitation for FAST TRACK Phase II awards. Gap funding will not be considered for other Phase II awards.

In order to enhance Phase II efforts and to assist in assuring acquisition support from the DTRA SBIR program, the Agency may provide a Phase II Awardee with additional Phase II SBIR funding beyond the initial award sum. The additional funding is conditioned on the company matching the additional SBIR funds with DoD acquisition funds or monies provided from external sources. At the discretion of the DTRA requiring activity, additional dollars may be provided by DTRA activities with heavy interest in the areas of endeavor being pursued by the Phase II award recipient under the SBIR contract applying the same matching arrangement. These conditions will be applicable to awards made pursuant to this DoD solicitation and subsequent solicitations, for a trial period not to exceed three years.

DTRA FY00 TOPIC DESCRIPTIONS

DTRA 00-001 TITLE: Biological and Chemical Agent Neutralization

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Exploitation of the high power electromagnetic beam/RF energy to neutralize chemical and biological agents that may be used in standard warfare or by terrorists. Of interest is the potential for totally destroying the chemical and biological potency. This may be accomplished by breakdown of the agents' molecular (chemical-bond) structures due to resonance interaction with the specific frequencies of the tunable high power, remotely operated EM single or multiple sources; and/or by other chemical or physical means.

DESCRIPTION: Collateral effects which may be created when attacking an enemy chemical or biological facility pose an important problem. The problem is more severe for chemical agents than for biological agents due to the large amounts stored in typical facilities. There are several methods which may prevent collateral casualties from agents released into the atmosphere and agents remaining in the facility. These include irradiation by RF sources and other chemical and physical means.
Using air-dropped munitions and/or irradiation of EM beam power levels, frequency bands of the RF source resonant with those of the chemical/biological molecules' rotational and vibrational energy bands/levels need to be investigated. Critical resonant frequencies and RF power levels that cause the desired effects in typical agents need to be identified and analyzed. Also, controlled experiments to check the results of the analysis shall be proposed.

In addition to or in lieu of irradiation, other chemical or physical means of neutralizing chemical and/or biological agents released into the atmosphere and remaining in the facility are needed.

Proposals using any single method or combination of methods are sought.

PHASE I: Identify chemical/biological agents of interest. Conduct initial studies as to the possible RF frequency bands and in-band energy density required to inactivate or destroy the agents' molecules individually and/or other possible chemical or physical methods to neutralize hazardous agents. Determine critical frequencies, waveshapes, and power levels along with the rep-rates of the EM power source and/or identify other chemical or physical methods to neutralize agents . Demonstrate the effectiveness of the source/method/chemical against selected agents.

PHASE II: Complete develop and demonstrate the methodology identified in phase I in a realistic large-scale environment. Improve the methodology so that more than one type of the targets and agents can be neutralized or destroyed effectively. Also develop methodology for assessing damage in-toto of the typical chemical/biological agents.

PHASE III DUAL USE APPLICATIONS: The methodology developed could be applied in a broad range of military and civilian applications where effective neutralization of chemical or biological agents is needed e.g., medicine and industry.

KEY WORDS: Chemical or biological agents, neutralization, molecular structure, RF source, munitions, containment.

REFERENCES: (U) Agent Defeat Weapon Program Review 98-2 Meeting Minutes, 28-29 October 1998, NWCA-MM-98-5, AF NWCA (CP), Kirtland AFB, NM 87117.

DTRA 00-002 TITLE: Multiple Sensor Characterization of Inaccessible geologic Formations for Hard Target Defeat

TECHNOLOGY AREAS: Weapons

OBJECTIVE: Develop methods to assess the weapons penetrability of near-surface geologic materials at inaccessible sites by exploiting multiple sensor signatures from visible, infrared, and radar earth remote sensing systems.

DESCRIPTION: The use of earth-penetrating weapons, either conventional or special weapons, is critically dependent on the near surface geological characteristics of target regions. For example, mere division of near-surface materials into soil or rock provides a first order set of information on which to evaluate the penetrability of an area. In addition, mere assessment of soil covered areas as tree covered or clear, provides an additional evaluation of the effectiveness of penetrating weapons. Finally, more refined evaluation of rock penetration can be accomplished with simple assessments of rock unconfined compressive strengths, rock quality, and rock size distributions. Exploitation and fusion of civilian remote sensing systems, such as the LANDSAT series and the Shuttle Imaging Radar/RADARSAT series can estimate such information. As a result of these open collectors, and the advances in data fusion resulting from computer processing advances, Small Businesses should be able to develop advanced multiple sensor data fusion systems that could have critical implications for use of earth-penetrating weapons and, with minor variations, could have extensive civilian applications. This development supports the following Counterproliferation Support and Operations Directorate programs: Hard Target Defeat, Special Ops Forces Support, and CP Analysis and Planning System (CAPS).

PHASE I: Design and demonstrate a prototype overall exploitation system that includes specification of penetrability mapping approach, multiple sensor data requirements, and data fusion techniques. Proposer should include compatibility of exploitation system with the DTRA IMEA-N (Integrated Munitions Effectiveness Assessment – Nuclear) targeting and damage assessment system in the design.

PHASE II: Complete development and demonstrate prototype exploitation system to include prototype penetrability maps on at least three areas of interest. Demonstration will include IMEA-N compatibility and utility.

PHASE III DUAL USE APPLICATIONS: Similar remote sensing data fusion techniques have broad applications in Land-Cover Mapping, engineering applications and mining patterns, agriculture and soils assessment, and urban-industrial patterns assessments.

DTRA 00-003 TITLE: Atmospheric Transport and Dispersion of Nuclear, Chemical, Biological, and/or Radiological Substances in Urban Areas

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop and apply a viable methodology for solving the urban transport problem.

DESCRIPTION: Hazard Prediction and Assessment Capability (HPAC) identifies danger areas caused by release of nuclear, chemical, biological, and/or radiological (NBCR) substances. HPAC provides military and civilian planners and decision makers with projected consequences of possible events. HPAC also provides the war fighter or first responder confronted with a real world event with danger areas from NBCR releases. The HPAC Urban Modeling Program is being designed to meet military urban model requirements for collateral effects applications. The Program is being developed collaboratively with both DOE and UK. The DoD OIPT on M&S is not addressing applicability of models but considering V&V methodology concerns. DOE POC is Dr Page Stoutland, NN-20, and CDR John Wiedner, DP-23. UK POC is Dr Andrew Becket at DERA (Porton-Down). This program is being coordinated with CB defense JMSG business manager (Dr Ron Ferik) to coordinate CB defense and counterproliferation/ collateral effects activities in this area. This program is also being coordinated with Mr Carmen Spencer, Director of CB Defense at DTRA. HPAC supports the following Counterproiferation Support and Operations Directorate (CP) Programs: CP ACTD, CAPS, CATS, Force Protection, and Assessments and Mitigation Technologies. HPAC also supports two CP Enabling Centers: Modeling and Simulation, and Operational Support.

Currently HPAC models non-urban areas very well. However, in urban areas, street canyons, roughness and composition of roads, and varying building heights, shapes, and surface characteristics drastically affect dispersion of NBCR substances. HPAC needs more complex algorithms to accurately model NBCR dispersion and the associated casualties.

PHASE I: Determine how best to attack the urban modeling problem for dispersion. Develop enabling methodologies. Develop an algorithm which provides the 20% solution to the problem. Test and validate the algorithms. Apply HPAC with the algorithms in live, preplanned events, such as the Presidential Inauguration and the Winter Olympics.

PHASE II: Use the methodology developed in Phase I to significantly improve the accuracy of the Phase I algorithm. Desired accuracy in this phase is 70%.

PHASE III DUAL USE APPLICATIONS: This algorithm will provide military planners, operational military forces, and civilian first responders with the capability to accurately assess hazard areas resulting from release of NBCR materials in or near urban areas.

KEYWORDS: Hazard prediction, simulation, modeling, tests, operations, nuclear, chemical, biological, radiological, transport, dispersion, casualties, hazard areas

DTRA 00-004 TITLE: Supporting Weather for Atmospheric Release Modeling

TECHNOLOGY AREAS: Chemical/Biological Defense, Sensors/Electronics/Battlespace

OBJECTIVE: Improve existing and increase new initiatives in modeling, methodologies, and sensors relating to specification, forecasting, communication, and visualization of atmospheric conditions to worldwide application of hazard prediction tools. Scales of interest include altitudes of surface release of materials (0m) to missile intercept of hundreds of kilometers (120km). Additionally, scales span from urban influence to synoptic applications, with recent emphasis increasing for the urban environment.

DESCRIPTION: A growing threat of attack from factions or states involving nuclear, chemical, biological or radiological agents is cause for concern and requires preparation. Meteorology is key to determining the collateral effects of hazardous release. Being able to accurately forecast future or specify current meteorological conditions for a region of interest is crucial in determining the collateral effects of a hazardous release. The continual advance in computing has allowed atmospheric models to be run on today's platforms that are more powerful than supercomputers from only a few years ago. Numerical weather prediction (NWP) model resolution improvements will continue to lead to vast increases in data volume. Being able to communicate large amounts of data to field-deployed units' personal computers (PCs) in austere military conditions is a challenge. Methods of improving the meteorological input to the atmospheric transport model (ATM), without the need to transmit entire volumes of data, must be employed to keep transmission time minimal for immediate hazard prediction calculations. Meteorological sensors and techniques for their employment, such as data analysis or assimilation, that enhance the knowledge of the theater meteorological environment from 0-120km altitudes are sought. These sensors can also include "stand-off" capability for the battlefield environment. Sensors may include ground-, air-, or satellite-based systems, including remotely piloted aircraft equipped with meteorological and other sensors. Continual developments are needed for the lower layer meteorological prediction models but there are a vacuum of meteorological efforts for the region in the troposphere and beyond. Methods and techniques are being sought to improve efficiency of existing NWP, ATM, or other applications in a multiple-processor architecture, whether in a single box or many networked boxes. Another area of concern is characterizing the natural variability of weather and determining the uncertainty of a dispersion calculation given a particular meteorological situation as described by observed or forecast weather. Innovative ideas are sought to aid in estimating the uncertainty of a forecast or analysis, which may be a function of time, surface features, climate, resolution, etc.

PHASE I: Develop or adapt model, application, sensor, or technique and demonstrate operational utility toward hazard prediction modeling.

PHASE II: Develop and demonstrate prototype model, application, sensor or technique in an operational environment; test and evaluate to quantify accuracy, representativeness, and operability.

PHASE III DUAL USE APPLICATIONS: Techniques, models, and methodologies developed under this topic have a wide range of applications for military, civilian, and commercial sectors. New or improved weather-related products can be employed at DOD or national weather centers, university, or countless commercial weather establishments.

KEYWORDS: Meteorology, atmospheric modeling, numerical weather prediction, data assimilation, sensors, multiple-processor, weather, high altitude weather, visualization, hazard prediction, urban modeling

DTRA 00-005 TITLE: Source and Transport Modeling of Biological Agent Slurries

TECHNOLOGY AREAS: Chemical/Biological Defense

OBJECTIVE: Develop a viable methodology for modeling the source development and transport of biological agent slurries through the atmosphere.

DESCRIPTION: The proliferation of weapons of mass destruction (WMD) as seen during the Gulf War has created the need for research to quantify collateral effects and to develop a real time collateral effects prediction capability to decrease the possibility of non-combative casualties resulting from attacks on nuclear, biological and chemical facilities or enemy WMD use. The Defense Threat Reduction Agency (DTRA) is developing the capability to predict collateral effects as part of its Collateral Effects (CE) Program . Hazardous agent releases resulting from the use of conventional weapons against chemical or biological weapons production and storage facilities, including the weapons themselves, and enemy or terrorist use of weapons of mass destruction are characterized by physics based modeling tools and comprise the focus of this program.

The tools provide the capability to accurately predict the effects of hazardous material releases into the atmosphere and its impact on civilian and military populations. Such releases may derive from the use of WMD weapons or from conventional weapon strikes against WMD production and storage facilities. Similar effects may result from commercial nuclear, chemical or pharmaceutical accidents or terrorist action.

Existing hazard prediction software can model only dry biological agent releases resulting from weapons of mass destruction and the transport of dry agent particles through the atmosphere. These sources include bacterial spores and viral particles, which have been lyophilized or freeze dried and then milled to a fine powder. However, wet biological agents such as slurries are not currently modeled. A lack of data concerning factors such as droplet evaporation, humidity effects, purity and viability of the liquid agent, particle size and bins, agent degradation or kill, and dissemination efficiency has hindered wet agent modeling. An urgent need exists to develop a methodology to model the source term development and transport of wet biological agents or slurries.

The technical risk is high due to the lack of data on explosively released wet biological materials and their transport through the atmosphere.

PHASE I: Determine the data requirements to model the source term development and transport of wet agents. Develop a test plan to fill data requirements. Conduct testing to obtain data per the test plan.

PHASE II: Use the research in Phase I to develop the physics to model wet biological agents source development and transport.

PHASE III DUAL USE APPLICATIONS: There is potential value to the commercial sector relating to hazardous materials (HAZMAT) incidents or accidents and terrorist action. Data and technologies developed by this effort would be useful to commercial hazard prediction models such as CAMEO and MIDAS-AT as well as other government models.

KEYWORDS: Hazard prediction, simulation, modeling, nuclear, chemical, biological, radiological, transport, dispersion, casualties, hazard areas

DTRA 00-006 TITLE: EM Measurements of Manmade and Natural Geomaterials

TECHNOLOGY AREAS: Chemical/Biological Defense, Sensors/Electronics/Battlespace, Weapons

OBJECTIVE: Development of a procedure for electric potential measurements during uniaxial or triaxial laboratory testing of rock and concrete specimens.

DESCRIPTION: Two years ago DTRA/CPTP began making simple electric potential measurements on field tests involving live weapon drops and static detonations in rock. The original objective of these measurements was to provide, from a remote location, detonation time diagnostics to determine weapon performance and status. These measurements have provided good information for this purpose; 1-3 channels of electric potential measurements are now standard on all CPTP field tests; our data set now contains electric records from approximately 25 tests. However, examination of the electric records obtained from both non-detonation events as well as signals produced during the penetration phases of the live weapon drops suggests that electric activity is generated by the penetration/damage process and not the detonation process. A very limited literature search has suggested that electrical emissions, due to microfracturing are observed when rocks are stressed in the laboratory which could be extended to field experience. Determination of electrical properties and electric potential or other EM type measurements of natural or man-made rocks during the standard stress-strain tests in the lab should aid in establishing a tie between damage processes and the observed electrical activity in the field testing.

PHASE I: Development of a methodology and procedure for measurement of electric potential during laboratory rock and concrete uniaxial and triaxial loading tests.

PHASE II: Tests of important rock types that correspond to penetration and high explosive loadings.

PHASE III DUAL USE APPLICATIONS: Extension to oil and mining production companies. The goal of this effort is development of a technique for correlation of observed electrical activity with degree of material damage.

KEYWORDS: Rock Fracture, Piezoeletric Effects, Electric Potential, Rock Properties.

DTRA 00-007 TITLE: Arms Control Activity Remote Monitoring

TECHNOLOGY AREAS: Information Systems, Sensors/Electronics/Battlespace

KEY TECHNOLOGY AREAS: Information Systems Technology, Sensor Software Technology

OBJECTIVE: Enhance capabilities to remotely monitor arms control treaty compliance-related activities at specific locations without disclosing sensitive or classified information and/or distinguish between allowed and disallowed activities. The goal is an algorithm and system design that would perform data fusion from a variety of sensor types installed at a facility and apply a set of behavior rules to monitor a security area without disclosing sensitive or classified information.

DESCRIPTION: Technology able to support the verification of future arms control treaties is needed to allow treaty inspectors to monitor the transportation, dismantlement, and storage of treaty limited items. Many Object and Pattern Recognition (OPR) systems based on video surveillance input have been demonstrated. Some arms control applications may prohibit the use of video images due to sensitive or classified objects and/or activities in the field of view. The security issue may be resolved by replacing or complementing video cameras with other sensor technologies such as IR or radiation detectors.
A remote OPR system is advantageous because it provides a less intrusive alternative to full time inspector presence in sensitive areas. Monitoring must have minimal impact on normal operations while protecting against illicit activities such as diversion or theft.

Current algorithms based on optical images are able to identify treaty limited objects and monitor security protocols such as a two-man rule. The developed algorithm should be able recognize items of interest and have behavioral rules defined so that prohibited actions can be recognized and trigger alarm conditions. Some of the limitations of an optical-based OPR system such as shadowing and obscuration can be overcome by combining sensor technologies. Radiation detectors would be applicable for a strategic treaty verification tool. Flexibility of application and circumstance is important. Ideally, the operator/inspector will never see visual images.

The developed algorithm should use an innovative approach to combine the capabilities of multiple (performer selected) COTS sensor technologies to enhance object and pattern recognition for the remote monitoring of special nuclear material at a fixed storage location. A preference will be given to self-correcting or learning algorithms over hard-wired decision tree algorithms. The algorithm should be capable of evaluating data at a rate of at least 30 times per second.

PHASE I: Develop software algorithm and system design based on input of multiple COTS sensors of at least two different sensor technologies. The design should include data acquisition and sensor specifications in order to remotely monitor 20-gallon sized containers of nuclear material.

PHASE II: Develop and demonstrate a prototype system in a realistic nuclear storage environment. Conduct testing to prove feasibility over extended operating conditions.

PHASE III DUAL USE APPLICATIONS: a remote OPR monitoring system has a wide variety of military and commercial applications for surveillance and security. Examples are the remote monitoring of nuclear components and reducing manpower requirements to secure industrial facilities.

KEYWORD LIST: arms control verification, arms control compliance, pattern recognition, sensor fusion, remote monitoring

DTRA 00-008 TITLE: Alternative Technologies for Nuclear Weapon Treaty Verification

TECHNOLOGY AREAS: Chemical/Biological Defense, Information Systems, Sensors/Electronics/Battlespace, Weapons, Nuclear Technology

OBJECTIVE: Define and develop non-nuclear radiation based "alternate technologies" for use in verifying the presence or absence of nuclear weapons, nuclear weapon components, and high explosives (HE) components from nuclear weapons located in containers. The goal is inexpensive, man portable, non-nuclear radiation based sensors capable of verifying future potential strategic treaties without revealing classified nuclear weapon design information, that can be operated by non-technical inspector personnel.

DESCRIPTION: Technology able to support the verification of a future potential START III treaty is needed to allow treaty inspectors to verify the presence or absence of nuclear weapons, nuclear weapon components, and high explosives (HE) components from nuclear weapons located in containers prior to warhead dismantlement. An additional requirement is the absolute need to protect critical nuclear weapon design information during and after verification measurements.

Numerous nuclear radiation detection based verification systems have been designed, developed, tested and produced. An inherent problem with these systems is they provide too much information, therefore revealing critical nuclear warhead design information during verification measurements. As an alternative, DTRA is in the early stages of determining alternate technologies based on all other non-nuclear radiation based physical principles and signatures of nuclear weapons for making verification measurements while protecting critical nuclear weapon design information.

The performer has significant flexibility, since any non nuclear radiation detection technology and a wide range of verification approaches should be considered. Examples of technologies requiring development to establish technical feasibility include 1) chemical microsensors and accurate yet portable gas chromatographs tailored to sample and analyze a nuclear weapon container atmosphere and 2) a mass properties sensor tailored to analyze induced acoustic vibrations from the contents of a nuclear weapon container through the container wall and related air-gaps.

Research is needed to define and then develop potential verification systems based on alternate technologies. Additionally, simple simulators should be developed that simulate, to the extent possible in a commercial unclassified environment, the makeup of the nuclear weapon environment. Finally, initial testing should be done with the developed system against those simulators, in preparation for final tests against classified Department of Energy simulators or real warheads and components.

PHASE III DUAL USE APPLICATIONS: Counter-proliferation & non-proliferation – for example, monitoring of nuclear materials associated with civilian nuclear power plants. Law enforcement, customs and border inspections – for example, inspection of sealed containers for weapons/drugs or of atmosphere of truck shipments for nuclear materials. Industrial and laboratory security – Similar to customs application, to detect theft of high value or nuclear items in containers.

KEYWORD LIST: Acoustic, Heat Transfer, Infrared, Chemical Microsensors, Gas Chromatography, Chemical Analysis, Arms Control Verification, Arms Control Compliance, Warhead Monitoring, Nuclear Weapons, High Explosives

DTRA 00-009 TITLE: Innovative Methods of Identifying Nuclear Explosions Versus Chemical Explosions and Natural Events

TECHNOLOGY AREAS: Chemical/Biological Defense, Sensors/Electronics/Battlespace, Weapons

OBJECTIVE: Develop innovative sensors whose outputs may be combined with seismic signals to distinguish between nuclear explosions, chemical explosions, or natural events

DESCRIPTION: Global networks of sensors have been, and are being, deployed to monitor for clandestine nuclear tests. One processing center for data from such a network is being developed at the Center for Monitoring Research (CMR) in Arlington VA in support of the Comprehensive Nuclear Test Ban Treaty (CTBT). The sensor data streams at CMR include hydroacoustic, infrasound and radionuclide sensors as well as seismic. These sensors are called out in the CTBT. A potentially powerful means of identifying the type of source of events ("discrimination"), particularly small events, in the seismic stream is to combine the seismic signals with signals from one or more of the other sensor data streams ("data fusion"). Identification of these small events, however, can still be problematic, with difficulties in distinguishing between small nuclear explosions, chemical explosion, and small earthquakes. Therefore, DTRA has a need for the development of sensors other than the ones currently being used (hydroacoustic, infrasound, and radionuclide) to assist in the identification of source type for small events in the seismic data stream. The CTBT does provide for additional types of sensors if these sensors would be useful in better identifying and locating events. Innovative approaches, such as sensors detecting changes in the Earth's gravity field or electromagnetic field, may be of interest. New concepts for identifying radionuclide products (such as tunable laser excitation). Space-based sensors, however, will not be considered. The work should include appropriate algorithms to carry out the identification of source type.

PHASE I: Carry out preliminary design of proof-of-concept tests.

PHASE II: Build prototype/acquire sensor(s), conduct test sufficient to demonstrate proof-of-concept.

PHASE III DUAL USE APPLICATIONS: A successful proof-of-concept test could lead to deployment of a new sensor network to assist in treaty compliance monitoring. Additionally, sensors based on measurements of the earth's gravity field or electromagnetic field could lead to improved scientific monitoring of the earth. These types of sensors, or sensors based on other principles, could be used to detect and monitor natural events (included those potentially hazardous).

REFERENCES: www.pidc.org

KEYWORD LIST: seismic signals, nuclear explosions, chemical explosions, discrimination, fusion, sensors

DTRA 00-010 TITLE: Innovative Infrasound Sensors with High Reduction of Natural Background Noise

TECHNOLOGY AREAS: Sensors/Electronics/Battlespace

OBJECTIVE: Design and prototype innovative sensor for infrasound (low frequency sound) with high signal-to-noise ratio for spatially coherent signals

DESCRIPTION: The opening of the Comprehensive Nuclear Test Ban Treaty (CTBT) for signature has reinvigorated the field of infrasound (low frequency sound) because the CTBT specifies a network of infrasound sensors to monitor compliance with respect to atmospheric nuclear tests. At present, the bandwidth of interest is 0.02-4 Hz. One of the problems in the detection of the infrasonic signals from atmospheric tests is that the technology uses extended sensing systems and arrays that average pressures over meters to kilometers of distance to reduce the effects of local variations and to enhance the effects of propagating pressure fronts. These sensing systems, however, are still sensitive to weather conditions (especially snow) and greater signal to noise performance is needed. New, innovative techniqueswith infrasound sensors are sought that can reduce the effects of local pressure variations and increase the resolution of infrasonic signals from atmospheric explosions. Issues are improved signal to noise performance in the frequency band, improved durability in remote deployments and environmental extremes, ability to operate in all-weather conditions, and cost.

PHASE I: Demonstrate concept by a benchtop model or other means.

PHASE II: Build prototype and conduct field tests to demonstrate superiority over current sensor.

PHASE III DUAL USE APPLICATIONS: Environmental monitoring.

REFERENCES: www.pidc.org

KEYWORDS: Infrasound, CTBT, Comprehensive Nuclear Test Ban Treaty, Sensors, Acoustic, Spatial Filtering.

DTRA 00-011 TITLE: Low Power, Room Temperature Systems for the Detection and Identification of Radionuclides from Atmospheric Nuclear Tests

TECHNOLOGY AREAS: Chemical/Biological Defense, Sensors/Electronics/Battlespace, Weapons, Nuclear Technology

OBJECTIVE: Innovative approach to the detection of airborne radionuclides with room temperature sensors.

DESCRIPTION: Detecting clandestine nuclear tests requires monitoring the environment to detect anomalous events. Two sensors in the Comprehensive Nuclear Test Ban Treaty (CTBT) monitoring system are systems designed to detect radioactive particulates and Xenon isotopes respectively from atmospheric nuclear tests. At present, these systems require mechanical cooling in order to achieve the necessary sensitivity and resolution of the germanium gamma-radiation sensor. This need to cool the detector results in high power consumption as well increasing the size and bulk of the detector and associated equipment. Another way of cooling the detectors is to use liquid nitrogen, as is often done in laboratories. However, these detectors will be placed in locations where liquid nitrogen is not readily available. DTRA therefore seeks an alternative approach, one that would eliminate the cooling requirement, for use in the remote and environmentally hostile locations associated with projected CTBT monitoring requirements. This new approach would have the detector performing at normal room temperatures. Alternative approaches would likely involve new materials since all current technology germanium detectors require cooling. The proposed approach should reduce the amount of power required by the sensor system, have good signal to noise ratios, still be of reasonably small size, with sensitivity and resolution on the order of current germanium detectors.

PHASE I: Demonstrate concept via breadboard model or other means

PHASE II: Build prototype and conduct tests sufficient to demonstrate proof-of-concept

PHASE III DUAL USE APPLICATIONS: Unattended radiation monitoring capability for industrial and medical facility monitoring.

REFERENCES: www.pidc.org

KEYWORD LIST: gamma detectors, gamma radiation, nuclear test, radionuclide, xenon

DTRA 00-012 TITLE: Tracking Atmospheric Plumes Based on Stand-Off Sensor Data

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop an approach to identifying and locating the source of nuclear events that generate atmospheric plumes by backtracking their atmospheric plumes.

DESCRIPTION: At present, a worldwide network of 80 radionuclide monitoring stations is being set up under the Comprehensive Nuclear Test Ban Treaty (CTBT) to monitor radioactive fall-out from atmospheric nuclear tests. These stations sample the air for radioactive particulates and radioactive Xenon on a daily basis. To interpret the results, a means of estimating where any suspicious radionuclides might have originated is needed. However, no automated process exists that will allow determination of possible sources of any detected radionuclides, nor is it clear what approach would work. Software exists that will track a plume forward in time from its origin, but no comparable software exists for tracking a plume backward in time. The ability to rapidly and automatically track a plume backward in time would greatly enhance the value of the radionuclide detectors. DTRA therefore seeks a software system that will track a plume backward in time, thereby allowing a projection of the potential origin of air parcels sampled by a monitoring station. Ideally, an accuracy of 1,000 sq. km. would be desirable. The system should take account of the properties of the radionuclides involved (e.g., settling, washout by rain, chemical reactions) as well as weather patterns. Appropriate historical data to test the system should be identified, and such a test should be part of the proposed work. The system is being considered for the Prototype International Data Center (PIDC) presently being developed for the CTBT, and should be able to use the type of data being produced at the PIDC. Off-line analysis is envisaged. Either an automated or interactive system, or a combination of both, will be considered.

PHASE I: Develop overall software system design and demonstrate proof-of -concept

PHASE II: Produce prototype software modules and conduct tests showing validity of approach.

PHASE III DUAL USE APPLICATIONS: Atmospheric monitoring of pollutants from fixed sources, such as power plants (nuclear and non-nuclear)

REFERENCES: www.pidc.org

KEYWORD LIST: radionuclide, atmospheric plumes, backtracking, atmospheric nuclear tests, fall-out, weather, meteorology, pollutants.

DTRA 00-013 TITLE: Improved Seismic Event Location Estimates

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Innovative Techniques for Developing Improved Hypocenter Location Estimates to Reduce the Area of Potential Search for Suspicious Events under the Comprehensive Nuclear Test Ban Treaty (CTBT).

DESCRIPTION: Under the CTBT, all nuclear testing by the signatory states is illegal. To enforce this ban, an international monitoring system is being developed to detect clandestine tests. It will consist of seismic, hydroacoustic, infrasonic, and radionuclide sensors. If an anomaly is detected with any of these sensors, member states have the right to demand an On-Site Inspection to obtain direct evidence of a treaty violation. The area to be inspected will probably be defined by the uncertainty ellipse obtained from seismic arrival data. The maximum allowable search area under the treaty is 1,000 km2. Because this is a relatively large area, and because exhaustive searches of such regions can be difficult and expensive, there is a need to develop new, innovative techniques for obtaining improved hypocenter estimates. These new techniques should both increase confidence in the coordinates obtained for the event and reduce the parameter uncertainty estimates to a minimum. Potential modes of accomplishing this improvement include, but are not limited to, the use of data from seismic stations that are not part of the CTBT International Monitoring Station (IMS) system, the use of data from non-seismic systems, and the development of new analytical approaches (such as Artificial Intelligence). For data from non-IMS sources, data quality control is an issue of interest and innovative techniques will be needed to rapidly determine the usability and degree of confidence to be placed in these data. Any proposed approach must involve operations that can be accomplished within a relatively short time frame (a few days) and that will yield results with a high degree of confidence, both scientifically and politically.

PHASE I: Develop overall system design and demonstrate proof-of -concept

PHASE II: Produce prototype software modules and conduct tests showing validity of approach.

PHASE III DUAL USE APPLICATIONS: Better and more rapid location of earthquakes, thereby allowing rapid determination of future seismic hazards.

REFERENCES: www.pidc.org

KEYWORD LIST: Seismic, hydroacoustic, infrasonic, nuclear test, location, hypocenter, artificial intelligence, data analysis

DTRA 00-014 TITLE: Innovative Wide-Area Detection and Mapping Technologies to Locate Minefields Containing Antipersonnel Landmines

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Develop innovative technical capabilities to detect and map APL minefields for use in verification and monitoring regimes of potential APL agreement/ban treaties such as the Convention on Conventional Weapons (CCW) Modified Protocol II, the Ottawa Convention on APL Ban, the Conference on Disarmament (CD) Process for APL Ban and others as appropriate.

DESCRIPTION: The US government has a long-range goal of banning the indiscriminate use, export, stockpiling and production of APL to mitigate or eliminate post-conflict civilian casualties. The Defense Threat Reduction Agency (DTRA) is responsible for providing RDT&E support for all arms control treaties including the proposed ban on APL. To verify and monitor APL ban provisions and to provide requisite technical assistance in conducting APL mapping and demining operations, DTRA is seeking innovative and statistically meaningful technical capabilities for WAD that have the potential to minimize risk to inspection/remediation personnel. DTRAs limited review of other WAD technology R&D efforts sponsored by other US Government (USG) offices and Separate Operating Agencies (for example, see references) determined that technical efforts have concentrated on detecting and clearing individual mines rather than on WAD and mapping of APL minefields. DTRA seeks innovative “out of the box” WAD R&D technology developments that will allow safe and rapid delineation of boundaries of areas containing mines. Proposed technologies and systems may include model and algorithm development to accomplish minefield detection and location display as well as full-scale prototype hardware and software developments associated with fieldable prototype demonstration systems.

The potential needs of DoD and DTRA germane to an agreement banning APLs are focused on developing multiple innovative WAD technologies and proof-of-concept prototype systems for worldwide APL detection, verification, and mapping use. Multiple R&D technology developmental efforts may be funded. The following are desired constraints on the proposed innovative WAD and mapping technologies/systems:

- High probability of detection of minefields containing metallic and non-metallic APL
- Real-time display or processing of data not required
- Large area coverage
- Detection operations conducted under non-hostile conditions

PHASE I: Demonstrate feasibility of the proposed innovative WAD and mapping technologies (or suite of technologies), models, algorithms. Provide logical approach and develop overall conceptual design of applicable WAD and mapping system that confirms the presence or absence of APLs.

PHASE II: Develop proof-of-concept prototype device/system that demonstrates the viability of the proposed innovative technologies, etc., to detect and map APL minefields. Submit final prototype design of the proposed WAD and mapping system.

PHASE III DUAL USE APPLICATIONS: Detection of unexploded ordnance (UXO) as part of military base clean-up operations in the US as well as arms control treaty/agreement applications.

REFERENCES:

1. GAO Report on UXO, Report No. 95-197, 20 SEP 1995.
2. Review & Identification of DOE Laboratory Technologies for Countermine/Unexploded Ordnance Detection, Cyrus Smith, Oak Ridge National Laboratory, 2 DEC 1996 (Reissued 2 DEC 1997).

DTRA 00-015 TITLE: CW Field Analysis Using Novel Sample Preparation Methods

TECHNOLOGY AREAS: Chemical/Biological Defense, Sensors/Electronics/Battlespace

OBJECTIVE: Explore innovative technologies and methods to increase the speed and accuracy of Chemical Warfare (CW) agent analysis by Gas Chromatography/Mass Spectrometry (GS/MS) in field environments in order to improve inspector safety and US capability to demonstrate its compliance with and verify/monitor compliance of other states parties with existing and future arms control treaties and agreements including the Chemical Weapons Convention (CWC) and a Bilateral Destruction Agreement (BDA).

Gas Chromatography/Mass Spectrometry (GC/MS) is a mainstay of chemical agent analysis for compound detection and identification. Next generation mass spectrometers are being developed for Chem-Bio Defense and include Time-of-Flight (mini-TOF), Matrix-Assisted Laser Desorption/Ionization (MALDI), and a threshold photoionization quadrupole ion trap/time-of-flight mass spectrometer for rapid analysis of chemical agents, biological agents, and explosives. Introducing samples such as water, soils, or wipe matrices into the mass analyzer requires a series of preparation procedures conducted prior to the determinative analysis. To date, sample preparation technology has not kept pace with instrument developments.

There is a requirement to identify and develop innovative technologies and methods to increase the speed and minimize the logistics for conducting sample analysis for chemical warfare (CW) agents by GC/MS. GC/MS has been accepted as the preferred method for determinative analysis for CW by the Organization for the Prohibition of Chemical Weapons (OPCW). Samples are collected and analyzed for the presence of CW agents, degradation compounds, and/or precursor chemicals (Schedules 1, 2, & 3) as specified in the "Annex on Chemical Contents, Section B" of the Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on Their Destruction. Schedule I compounds include the threat agents typically monitored in a battlefield environment. In addition to the collection of ambient air samples, the capability to collect more complex matrices is necessary to ensure a safe battlefield environment. Samples also may be collected and analyzed in order to satisfy implementation requirements under the CWC and in support of a future Bilateral Destruction Agreement (BDA).

Direct sample introduction of most environmental matrices (water, soil/solids, wipes/swipes) into mass spectrometer instrumentation is not feasible. A series of procedures must be employed to extract the compounds of interest (e.g., target analytes) into an organic solvent media more appropriate for conducting determinative analysis by GC/MS. Sample preparation protocols are the same when confirming the safety of a battlefield environment or verifying compliance with the CWC Development of automated sample preparation techniques is desired to permit continuous analysis. Sample preparation and subsequent instrument analysis will be performed in field laboratory environments.

DESCRIPTION: Preparing environmental samples prior to GC/MS analysis remains a "weak-link" in the sampling and analysis process. The preparation of samples for GC/MS analysis currently includes liquid/liquid or liquid/solid extractions, and subsequent derivitization reactions. These procedures are time-consuming and can be complex, use specialized equipment, and the protocols have specific reaction times conducted at recommended temperatures. Currently, as few as five samples can be prepared for analysis during an eight hour time period using existing analytical procedures. This throughput is unacceptable during a time-oriented mission such as the 84-hour on-site limit specified under the CWC during the conduct of a challenge inspection. Furthermore, the analytical procedures involve significant sample handling that may adversely affect sample extraction efficiency. The rigorous protocols increase the exposure risk of laboratory personnel to contaminants that may be present in the sample matrix including chemical agents. Extensive sample handling also leads to the potential of inadvertent sample contamination/ cross-contamination, casting doubts on the authenticity of the analytical data.

The current extraction procedures are complex, requiring specialized operator expertise and training. Also, the existing procedures require the use of potentially hazardous reagents (e.g., flammable solvents), adding to the complexity in deploying a transportable laboratory. To date, the techniques have been unable to extract critical compounds from specific environmental matrices and have not been able to result in reproducible analytical determinations. It is critical that the analytical procedures be conducted to ensure that resulting GC/MS analysis data are reproducible at detection limits that meet treaty requirements, generally in the 10-ppm range.

Devices, materials, and procedures will be developed to significantly improve sample preparation in the GC/MS analytical process. All devices and materials must specifically target extraction of CW agents, precursors and degradation products. The procedures must successfully perform in the presence of significant environmental interferents or contaminants (e.g., hydrocarbon backgrounds). Performance will be characterized by sample throughput, ease of conducting the procedures, success in extraction of key analytes, resultant reproducibility of GC/MS detection data, and toxicity of extraction materials used (if applicable). Extraction throughput goal will be to prepare no fewer than 16 individual samples (comprised of various matrices) during an eight hour time period.

PHASE I: Demonstrate the feasibility/proof-of-concept of alternative extraction equipment, materials, and procedures for use in the preparation of environmental samples to include water, soil/solids, wipes/swipes for GC/MS analysis of compounds related to chemical arms control treaties and agreements (CW agents, precursors, and degradation compounds).

PHASE II: Develop proof-of-concept and reduce to practice; demonstrate the proposed technology; prototype methodology/standard operating procedures; conduct field trials.

PHASE III DUAL USE APPLICATIONS: Investigate use for Counter-Terrorism/ Domestic Preparedness; environmental on-site analysis for remediation/hazardous waste assessment/clean-up (e.g., DoD installations)

DTRA 00-016 TITLE: New Innovative Technologies for the Development and Demonstration of Radiation Hardened Microelectronics and Photonics

TECHNOLOGY AREAS: Materials/Processes, Sensors/Electronics/Battlespace, Nuclear Technology

OBJECTIVE: Develop and demonstrate innovative concepts, methods and technologies for the radiation hardening and radiation effects characterization of semiconductor microelectronics and photonics devices, circuits and materials.

DESCRIPTION: Radiation effects from either nuclear weapons or the natural space environment can degrade or destroy semiconductor microelectronic and photonic devices, circuits or materials. Moreover, as microelectronics and photonics technologies continue to evolve their susceptibility to radiation effects increases in many cases. In addition the problems associated with the characterization of radiation effects in these advanced technologies also are becoming more difficult. Thus, future methods to radiation harden microelectronics and photonics and to characterize their radiation response will require the development and demonstration of new cost-effective and minimally invasive concepts, methods and technology.

Very deep submicron microelectronics has been shown to be extremely susceptible to radiation effects. These devices use small feature size and many new types of materials to achieve high performance to the detriment of radiation robustness. Thus, minimally invasive concepts, methods and technology to increase radiation hardness without loss of electrical performance or significant increase in cost are required. Moreover, methods to characterize the radiation response of the new materials and devices are required.

Very high-speed microelectronics and photonic devices and materials have been developed to facilitate the rapid transfer of data. However, these devices and the subsystems fabricated using this advanced technology have been shown to be very susceptible to radiation effects. Here again, minimally invasive an cost-effective concepts, methods and technology are required to reduce the susceptibility of these technologies to radiation effects and allow them to be used in DoD missile and space systems. In addition new methods to characterize the radiation response of these technologies are required.

Very significant investments have been made by commercial semiconductor manufactures and system designers to develop extremely high performance circuits such as microprocessors, digital signal processors, microcontrollers, etc. However, for the DoD to take advantage of these developments these devices must be redesigned such that they can be fabricated using radiation hardened processes and design rules. One method to accomplish this redesign is through the use of Electronic Design Automation (EDA). Thus, cost-effective EDA concepts, methods and technology are required to support such an approach.

Traditionally the radiation response of microelectronic and photonic devices and circuits have been obtained through testing. However, such an approach is both costly and time consuming. A more cost-effective and accurate approach would entail the modeling and simulation of the basic response of a device or circuit starting with the initial fabrication parameters, e.g. material, temperature, time, etc. Thus, the development and demonstration of concepts, methods and technologies to simulate and model the radiation response of complex microelectronics and photonic devices are required to reduce our reliance on expensive and inaccurate radiation testing.

Presently used methods to ascertain the radiation hardness of a semiconductor device or circuit require destructive testing using a suitable radiation source. A more cost- effective approach would be to identify and correlate the electrical response of certain key device performance parameters to the radiation response. This would allow for the non-destructive characterization of device radiation performance and significantly reduce the need for expensive and time consuming radiation testing. Thus, the development and validation of concepts, methods and technology to demonstrate such an approach is required.

PHASE I: demonstrate the feasibility of the concept, method or technology.

PHASE II: develop, test and evaluate the concept, method or technology.

PHASE III DUAL USE APPLICATIONS: In addition to supporting DoD space and missile system applications the above-described thrusts will also serve to support commercial communications and scientific space system applications. This support will be of significant value to Dod due to significant use of commercial space systems assets for DoD applications, e.g. Iridium,etc.

REFERENCES:
(1) Messenger and Ash, "The Effects of Radiation on Electronic Systems", Van Norstrand Reinhold Company, 1986
(2) Dressendorfor & Ma,"Ionizing Radiation Effects in MOS Devices & Circuits",John Wiley & Sons,1989
(3) Glassstone and Dolan, The Effects of Nuclear Weapons, 1977
(4) Transient Radiation Effects in Electronics Handbook,DNA-H-95-61

DTRA 00-017 TITLE: New, Innovative Technologies for EMP/HPM Hardening of Military and Commercial Systems and Equipment

TECHNOLOGY AREAS: Materials/Processes, Sensors/Electronics/Battlespace, Nuclear Technology

OBJECTIVE: Develop and demonstrate innovative concepts, methods and technologies for hardening military and commercial-off-the-shelf (COTS) equipment, systems, and networks against the effects of nuclear Electromagnetic Pulse (EMP) and High Power Microwaves (HPM).

DESCRIPTION: Electromagnetic (EM) environments generated by nuclear and RF (radio frequency) weapons can degrade or destroy sensitive electronic and electrical devices. With improvements in integrated circuit technology, e.g., higher clock speeds, lower logic levels/gate thresholds, and smaller size, there is a trend towards greater susceptibility. This is exacerbated by component and equipment manufacturer's usage of non-conductive material (e.g., composites, plastics) to house the electronics. Thus, there is a need for innovative, cost-effective hardening technologies and methods for design, analysis, testing, maintenance and surveillance.

Integrated hardening and testing devices and techniques that address EMP, HPM, and other natural and man-made EM environments are desirable.

The military has mandated use of COTS (electronics) equipment to the maximum extent possible. A significant challenge is to ensure that COTS is survivable when integrated into military systems that must operate in and through EMP, HPM and other stressing EM environments found in the battlespace of the future. Methods, devices, and materials for characterizing and expediently/cost effectively hardening COTS are required.

The military is highly reliant on the commercial infrastructure for effectively accomplishing many of its missions. Innovative concepts and technologies for protecting critical elements of the U.S. infrastructure and tools/methodologies for use in assessing potential vulnerabilities are needed.

PHASE I: demonstrate the feasibility of the concept, method, or technology.

PHASE II: develop, test, and evaluate the concept, method, or technology.

PHASE III DUAL USE APPLICATIONS: In addition to supporting DoD equipment, systems, and networks hardening applications, the above thrusts will also serve to support commercial electronics equipment protection applications. This support may be leveraged by DoD since a) OSD has mandated the use of COTS equipment, materials, and commercial standards to maximum extent possible and b) the military is highly reliant to the use of the U.S. commercial infrastructure for the completion of many o f its critical missions.

REFERENCES:
(1) Glasstone and Dolan, The Effects of Nuclear Weapons, 1977
(2) MIL-HDBK-423, High-Altitude electromagnetic Pulse (HEMP) Protection for fixed and Transportable Ground-Based C4I Facilities, Volume I Fixed facilities

DTRA 00-018 TITLE: New, Innovative Technologies for X-Ray Simulators and Other Pulsed Power Applications

TECHNOLOGY AREAS: Chemical/Biological Defense, Weapons, Nuclear Technology

OBJECTIVE: Develop innovative technologies for the efficient production of x-rays for nuclear weapons effects testing and for the application of compact pulsed power to military and civilian systems.

DESCRIPTION: X-ray nuclear weapon effects testing uses radiation sources that generate primarily cold x-rays (1-15 keV), warm x-rays (5-60 keV), or hot x-rays (30 keV). Soft x-rays are used for optical and optical coatings effects testing; warm x-rays are used for thermomechanical and thermostructural response testing; and hot x-rays are used for electronics effects testing. Future requirements for x-ray nuclear weapon effects testing will require improvements in existing radiation source capability, to increase yield and power, improve spectral fidelity, and increase predictability and experimental control. These improvements may require new concepts in source design, experimental and measurement techniques, data analysis and modeling, and methods to reduce facility system and operation costs. The proposer should be familiar with the present capability to produce x-rays for nuclear effects testing.

Plasma Radiation Source (PRS) devices are typically gas puffs or wire arrays that are imploded by conduction of large currents to generate soft x-rays. Present PRS designs for high-power DTRA simulators are limited by Rayleigh-Taylor and MHD instability growth, and active research is investigating innovative load designs. Greater understanding is needed of factors influencing instability growth. Such factors include geometry, coupling to the generator, plasma properties, ionization dynamics and radiation transport. Innovative load designs might also include novel methods for increasing radiation yield and spectral fidelity in a high-power, optically thick medium, as has been done by using mixtures. An important contribution could come from physics-based modeling of this complex system, particularly with the high-performance parallel computers now available.

PRS devices generate copious amounts of extraneous debris (material, atomic charged particles, sub-keV photons), from which test objects must be shielded. Better techniques and diagnostics are needed to characterize the debris impacting a test object. Debris shields must minimize particle flux and maximize exposure area without significantly reducing x-ray fluence. New methods, or a combination of methods, may be needed to stop, mitigate, and/or delay debris generated for radiation simulators.

Plasma opening switches (POS) are important for obtaining maximum performance from x-ray sources, particularly with the next generation of DTRA high-power generators. Interest is focused primarily on using POSs for pulse sharpening in order to drive high fidelity bremsstrahlung diodes. POS performance appears to be affected by plasma composition, plasma flow symmetry, current diffusion during conduction, and power losses, and innovative diagnostics are needed to quantify these factors. Better computer modeling is needed, especially to understand the opening process and its relationship to conduction dynamics.

Bremsstrahlung Radiation Source (BRS) devices generate hot x-rays by impinging an electron beam onto a target converter. Improved BRS converter and/or beam transport designs are needed to meet future test requirements, by increasing x-ray production (dose), better tailoring pulse width (increased dose rate), and improving spectral fidelity. These improvements could be effected by innovative new BRS designs, or by better understanding and refinement of existing BRS designs. Comprehensive computer modeling (e.g., PIC codes) of cathode formation and electron emission, beam transport, and/or converter physics, could provide an important contribution.

Future requirements for systems employing pulsed power will necessitate improvements in efficiency, energy density, reliability, repeatability and overall performance over the existing state of the art. Innovative approaches for component or subsystems development are sought to meet future demands for radiation simulators and other pulsed power applications. Examples include more energy efficient pulse forming technologies, high energy density capacitors, more efficient insulators, improved and more reliable switching technologies, and improved power flow electrical circuit models. Pulsed power technologies include those that operate at kilovolts to megavolts and kiloamperes to megamperes, support repetition rates from single pulse to 10 kilohertz, and provide individual pulse risetimes in the nanosecond to millisecond range.

Current DoD pulsed power applications includes x-ray simulators, armor/anti-armor; electromagnetic/electrothermal guns; mine-countermine; electrical vehicle stoppers, and directed energy weapons; etc. Development of new and innovative applications requiring advanced pulsed power technology is also desired, especially applications that may expand a primarily DoD driven requirements base into the commercial sector and reduce component and system costs.

PHASE I: demonstrate the feasibility of the proposed concept.

PHASE II: develop, test and evaluate proof-of-principle hardware. In some cases this will be required to be demonstrated in its working environment on a radiation simulator that will involve coordination with DTRA to schedule testing in an above ground test simulator.

PHASE III DUAL USE APPLICATIONS: In addition to the applications cited for developing the environments for simulating the effects of nuclear weapons, the technologies could be useful with the commercial operations of advanced computer modeling of plasmas, nuclear instrumentation, very fast closing valves, material surface treatments, environmental clean-up and high brightness x-ray sources. In addition to the DoD applications cited, these pulse power component technologies will be useful in cleaning up smokestack effluents, general environmental pollution control, metal cutting, and electric vehicles.

REFERENCES:

(1) Inductive Energy Technology for Pulsed Intense X-Ray Sources, K. D. Ware, P. G. Filios, R. L. Gullickson, J. E. Rowley. R. F. Schneider, W. J. Summa, I. M. Vitkovitsky, IEEE Transactions on Plasma Science, Vol. 25, No. 2, April 1997.
(2) Glasstone and Dolan, The Effects of Nuclear Weapons, 1977
(3) DNA EM-1, Capabilities of Nuclear Weapons
(4) Radiation Test Facilities and Capabilities, 1997, DASIAC, 2560 Huntington Ave., Alexandria, VA 22303 (also on web site: http://www.dswa.mil/dswainfo/es/hp.htm)
(5) J. C. Martin on Pulsed Power, Edited by T. H. Martin, A. H. Guenther, and M. Kristiansen, Plenum Press, New York and London, 1996, ISBN 0-306-45302-9.